PROC. ENTOMOL. SOC. WASH.
93(2), 1991, pp. 511–514

ON THE OCCURRENCES OF *OPISTHIUS RICHARDSONI* KIRBY AND *ASAPHIDION YUKONENSE* WICKHAM (COLEOPTERA, CARABIDAE) AS LATE PLEISTOCENE FOSSILS

ALLAN C. ASHWORTH AND DONALD P. SCHWERT

Geology Department, North Dakota State University, Fargo, North Dakota 58105.

Abstract.—Numerous fossils of the carabids *Opisthius richardsoni* Kirby and *Asaphidion yukonense* Wickham are known from late Pleistocene and early Holocene deposits in midcontinental North America. Both species are presently restricted to riparian habitats of the Cordilleran foothills. Their fossil occurrences in the midcontinent are explained by reference to meltwater habitats associated with the growth and decay of the Laurentide ice sheet.

Key Words: Coleoptera, Carabidae, *Opisthius, Asaphidion,* Pleistocene, fossils

Don Whitehead was always fascinated with a good biogeographic mystery, and this one had him hooked. On a January morning in 1977 at the Smithsonian Institution, Don Whitehead confirmed the identification of a fossil elytron of the western-montane carabid species *Opisthius richardsoni* Kirby. The specimen was from a 12,500 yr B.P. (years Before Present) fossil assemblage at Norwood, Minnesota (Ashworth et al. 1981). *Opisthius richardsoni* joined a small, but growing, group of carabid species of western affinities occurring as fossils in midcontinental and eastern sites of late Pleistocene age. The first of these to have been discovered, *Asaphidion yukonense* Wickham, was from a 10,600 yr B.P. peat deposit in southern Ontario (Ashworth 1977). The question of why species with existing western montane distributions were present in lowland fossil assemblages more than a thousand kilometres to the east of the Rockies was as intriguing to Don as it was to us. On subsequent visits to the Smithsonian, Don would quiz us about the latest ideas that we had to explain the distributions of these species. Those ideas are expressed in this paper as a tribute to the stimulating conversations that we had with Don.

MODERN AND FOSSIL OCCURRENCES

Lindroth (1961) described the habitat of *O. richardsoni* as "confined to the banks of rivers and big brooks, on places where the soil is soft, consisting of clay, often mixed with sand and gravel." We have regularly collected this species on sand and gravel bars adjacent to cold, rapidly-flowing waters of streams in the Cordilleran foothills. Populations of this species occur from southern Alaska to Southern California, in a range that Lindroth (1961) described as "pronouncedly western" (Fig. 1).

Fossils of *O. richardsoni* have been recorded from sediments of late Wisconsinan age in northeastern Illinois (Garry et al. 1990b), north-central Iowa (Schwert, ms. submitted), south-central Minnesota (Ashworth et al. 1981), and northwestern Ontario (Schwert and Bajc, unpubl. data) (Fig. 1).

Lindroth (1963) reported that *A. yukonense* "occurs on the banks of running waters . . . often under leaves of *Salix* and

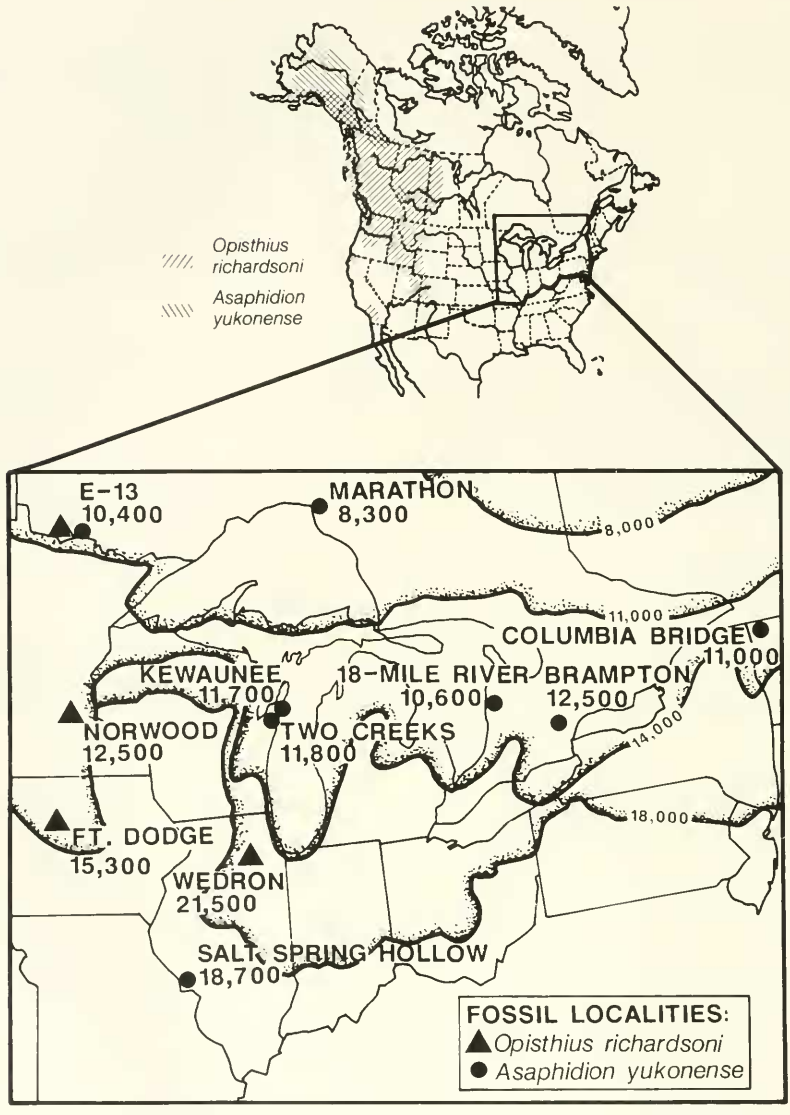

Fig. 1. The modern and fossil distribution of *O. richardsoni* and *A. yukonense*. The margins of the Laurentide ice sheet are shown at 18,000, 14,000, 11,000, and 8000 yr B.P. (after Dyke and Prest 1987).

Alnus where the vegetation is restricted to patches of tiny mosses." J. V. Matthews, Jr. (pers. comm. 1990) has collected the species on bare patches of loessic soils close to running water. The range of this species is more restricted than that of *O. richardsoni*, occurring in Alaska, Yukon Territory, British Columbia, and west-central Alberta (Fig. 1).

Asaphidion yukonense occurs as fossils in deposits of late Wisconsinan age in west-central Illinois (Schwert and Hajik unpubl. data), northeastern Wisconsin (Morgan and Morgan 1979, Garry et al. 1990a), Vermont (Matthews unpubl. data), southern Ontario (Ashworth 1977, Morgan et al. 1983), and northwestern Ontario (Bajc et al. 1986, Schwert and Bajc unpubl. data) (Fig. 1).

Discussion

The correlation between fossil occurrences and ice margin positions of similar age indicates that *O. richardsoni* and *A. yukonense* were inhabitants of the ice-marginal zone (Fig. 1). The occurrences of *O. richardsoni* at 21,500 yr B.P. at Wedron, Illinois, and at 15,300 yr B.P. at Fort Dodge, Iowa, were associated with the ice advancing to its late Wisconsinan maximum. The remaining occurrences of both species were associated with the ice-margin in the process of retreat, as is reflected by the sequential decrease in ages of fossil occurrences northward (Fig. 1).

Both *O. richardsoni* and *A. yukonense* presently occur on sparsely-vegetated banks of rapidly-flowing, meltwater-fed rivers. Riparian habitats of this type are no longer represented in central and eastern North America but were widespread throughout that region during the last glaciation. The vegetation based on pollen analyses of *O. richardsoni*-bearing sediments at Wedron, Illinois (Garry et al. 1990a), Fort Dodge, Iowa (R. G. Baker pers. comm.), and Norwood, Minnesota (Ashworth et al. 1981), was a mosaic of open areas and patches of spruce woodland.

Opisthius richardsoni and *A. yukonense* were members of insect communities that do not exist today. Non-analogous animal and plant communities characterized the unstable transitional environments of the late Wisconsinan. Community composition continually changed as species with different ecological requirements and dispersal capabilities responded to rapid environmental changes.

What were the conditions that led to the range expansion of *O. richardsoni* and *A. yukonense* into central and eastern regions of North America? We speculate that prior to the last ice advance these species may have had distributions in the Cordilleran foothills similar to those of today. As Laurentide ice advanced southward, meltwaters formed a complex of braided rivers and outwash plains south of the ice margin to the east of the Cordillera. From montane streams, southeastward dispersal of individuals across interfluves produced an eastward range extension for both species. Fossils of *O. richardsoni* have not been discovered east of Iowa and Minnesota, which during the late Wisconsinan may have been its easternmost range limit. *Asaphidion yukonense* was evidently more successful in eastward dispersal, as fossils are known from as far east as Vermont. As ice retreated northward, the meltwater stream habitats that had supported *O. richardsoni* and *A. yukonense* disappeared from the midcontinent. The loss of habitat resulted in their present range restriction to the Cordilleran foothills.

Opisthius richardsoni and *A. yukonense* are examples of species that underwent large-scale changes in range in response to climate change and glaciation. Occasionally, the combination of climatic change and ice barriers resulted in even more profound biogeographic effects. Fossil assemblages from 21,500 to 14,000 yr B.P. ice-marginal locations in Iowa and Illinois contain arctic species with distributions today restricted to Alaska, Yukon, and the Northwest Territories. We have proposed (Schwert and Ashworth 1988) that the southern populations of these species were extirpated as a result of climatic warming and competition for the ice-marginal environment by warmer-adapted species dispersing into the region from the south. The result of the elimination of populations of arctic species in the midcontinental region was that the Alaska-Yukon refugium became the principal source region for the repopulation of the arctic during the Holocene.

The fossil occurrences of *O. richardsoni* and *A. yukonense* can be understood in terms of the geologic record of environments known to have existed during the late Wisconsinan. The occurrences of other "western" species within these fossil assem-

blages are less easily explained. For example, the coccinellid *Hippodamia caseyi* Johnson, which today has a range extending from southern British Columbia to northern California and Colorado (Gordon 1985), was present at Fort Dodge, Iowa, 15,300 yr B.P. This species is not riparian, and its distribution cannot be directly linked to the disappearance of a glacially-associated habitat.

Acknowledgments

R. G. Baker, University of Iowa, provided the preliminary interpretation of pollen from the Fort Dodge site. Part of this research was supported by NSF Grant Nos. ATM-8805791 and RI-8610675. This is contribution No. 43 of the Iowa Quaternary Studies Group.

Literature Cited

Ashworth, A. C. 1977. A late Wisconsinan coleopterous assemblage from southern Ontario and its environmental significance. Can. J. Earth Sci. 14: 1625–1634.

Ashworth, A. C., D. P. Schwert, W. A. Watts, and H. E. Wright, Jr. 1981. Plant and insect fossils at Norwood in south-central Minnesota: A record of late-glacial succession. Quat. Res. 16: 66–79.

Bajc, A. F., B. G. Warner, and A. V. Morgan. 1986. Dating and paleontology of a postglacial fossil assemblage from the North Shore of Lake Superior, Ontario (abst.). Progr. and Abst. of the Am. Quaternary Assoc. Ninth Biennial Meeting, Univ. of Illinois. p. 70.

Dyke, A. S. and V. K. Prest. 1987. Late Wisconsinan and Holocene retreat of the Laurentide Ice Sheet. Geol. Surv. Can., Map 1702A.

Garry, C. E., R. W. Baker, D. P. Schwert, and A. F. Schneider. 1990a. Environmental analysis of a Twocreekan-aged beetle (Coleoptera) assemblage from Kewaunee, Wisconsin, pp. 57–65. *In* Schneider, A. F. and G. S. Fraser, eds., Late Quaternary History of the Lake Michigan Basin. Special Paper 251, Geol. Soc. Am., Boulder.

Garry, C. E., D. P. Schwert, R. G. Baker, T. J. Kemmis, D. G. Horton, and A. E. Sullivan. 1990b. Plant and insect remains from the Wisconsinan interstadial/stadial transition at Wedron, north-central Illinois. Quat. Res. 33: 387–399.

Gordon, R. G. 1985. The Coccinellidae (Coleoptera) of America north of Mexico. J. New York Entomol. Soc. 93: 1–912.

Lindroth, C. H. 1961. The ground-beetles of Canada and Alaska, Part 2. Opusc. Entomol. Suppl. 20: 1–200.

———. 1963. The ground-beetles of Canada and Alaska, Part 3. Opusc. Entomol. Suppl. 24: 201–408.

Morgan, A. V. and A. Morgan. 1979 The fossil Coleoptera of the Two Creeks Forest Bed, Wisconsin. Quat. Res. 12: 226–240.

Morgan, A. V., A. Morgan, A. C. Ashworth, and J. V. Matthews, Jr. 1983. Late Wisconsin fossil beetles in North America, pp. 354–363. *In* Porter, S. C. and H. E. Wright, Jr., eds., Late Quaternary Environments of the United States; Volume 1, The Late Pleistocene. Univ. Minnesota Press, Minneapolis.

Schwert, D. P. Submitted. Faunal transitions in response to an ice age: The late Wisconsinan record of Coleoptera in the north-central United States.

Schwert, D. P. and A. C. Ashworth. 1988. Late Quaternary history of the northern beetle fauna of North America: A synthesis of fossil and distributional evidence. Mem. Entomol. Soc. Can. 144: 93–107.

PROC. ENTOMOL. SOC. WASH.
93(2), 1991, p. 514

Editor's Note

The January, 1991, issue of this journal contained revised instructions to authors. Within the article it was stated that ESW page charges are $35.00 per page. This will remain in effect for all manuscripts published through the October, 1991, issue. Beginning with the January, 1992, issue, page charges will be increased to $40.00. Thereafter they are subject to change without notice to cover any change in printing costs.